

# THE ASCIDIANS OF SOUTH AUSTRALIA III. NORTHERN SECTOR OF THE GREAT AUSTRALIAN BIGHT AND ADDITIONAL RECORDS

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## Summary

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An account is given of 58 species of the Ascidiaceae from South Australia, of which 7 species are new, including two assigned to new genera in the sub-families Euherdmaniinae and Botryllinae.

Records of 22 species from the northern part of the Great Australian Bight are the first from that area and suggest that the ascidian fauna there has a considerable endemic component. Many of the species common in other parts of the Flindersian marine faunal Province have not yet been recorded from this location.

## Introduction

This account of the ascidian fauna of South Australia is based on the following collections: (1) from the northern part of Spencer Gulf (made in connection with environmental studies in that area); (2) from the northern part of the Great Australian Bight (made in connection with an experimental Prawn Trawl Survey, Explorer); (3) from Investigator Strait (collected by J. Watson) and from West Island; (4) additional collections from Elliston Bay at the eastern end of the Great Australian Bight (collected by S. Shepherd). The report is supplementary to previous papers on the South Australian ascidian fauna (Kott 1972a, 1972b). It includes records of 57 species, including 7 that are new to science. Two of these new species have been assigned to new genera in the sub-families Euherdmaniinae and Botryllinae. Four species are newly recorded from South Australia.

The occurrence of 6 new species in the northern part of the Great Australian Bight suggests an unusually high endemic component for the ascidian fauna of that area, and its zoogeography is discussed.

Type material is deposited in Australian museums as indicated by the abbreviations AM (Australian Museum), NMV (National Museum of Victoria), QM (Queensland Museum), and SAM (South Australian Museum).

All available collection data for the specimens discussed are given in the Appendix.

## Order ENTEROGONA

### Suborder APLOUSOBRANCHIA

#### Family CLAVELINIDAE

##### Subfamily CLAVELININAE

#### *Podoclavella cylindrica* (Quoy & Gaimard).

Kott, 1972a: 5 (synonymy); 1972b: 167.

*New Records:* Tipara Reef (Spencer Gulf); on reef NNW Douglas Bank (upper Spencer Gulf).

##### Subfamily HOLOZOINAE

#### *Distaplia australiensis* Brewin, 1953: 61. Kott, 1957: 95.

*New Records:* upper Spencer Gulf (Stn D5).

*Previous Records:* Tas. (D'Entrecasteaux Channel and southern Tasmania).

*Description:* Colonies consist of a rounded head on a short cylindrical stalk. There is a single terminal common cloacal aperture and the zooids are arranged along either side of the cloacal canals that radiate from this aperture and extend down the length of the head. There are about 12 fine longitudinal thoracic muscles. Ten stigmata are present in each of the four rows and these are crossed by fine parastigmatic vessels. There are 8 rounded stomach folds. The gonads extend, from the pole of the

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gut loop, into a short posterior abdominal extension separated from the abdomen by a short neck. Seven to 8 elongate testis lobes are arranged in a circle with their long axes parallel to one another to form a barrel shaped mass. The vas deferens, extending from the distal end of the centre of this mass, passes around it into the abdomen. There is also an ovary in the posterior abdomen.

**Remarks:** The colonies are identical with those previously assigned to this species. The zooids differ from those described by Brewin in the lesser number of stigmata in each row. Kott (1957) has reported some variation in this character and the differences are not regarded as significant. The presence of a parastigmatic vessel crossing the rows of stigmata has not previously been observed, but since this is very delicate it could have been overlooked.

**Sycozoa pedunculata** (Quoy & Gaimard). Kott, 1972b: 170; 1972d: 234 (synonymy).

**New Record:** upper Spencer Gulf (Sta B4).

**Atapozoa marshi** Brewin, 1956: 31. Kott, 1972b: 168.

**New Records:** Investigator Strait (Stns Y5, Z6).

**Description:** The specimens are of the usual form with a long cylindrical head terminating in a rounded point. The shorter fleshy stalk is almost the same diameter as the head. The colony from Sta Z6 is the largest yet recorded, measuring 17 cm of which the stalk is only 5 cm. The minute zooids are present in the surface layer of test with long posterior abdominal stolons penetrating into the centre of the lobe. There is the usual brown pigment patch over the anterior end of the endostyle.

#### Family POLYCITORIDAE

**Polycitor giganteum** (Herdman). Kott, 1972a: 9 (synonymy); 1972c: 244.

**New Records:** northern Great Australian Bight; West I. (Amphitheatre Rock).

#### Family POLYCLINIDAE

##### Subfamily EUHERDMANINAE

**Euherdmania australis** Kott, 1957: 103; 1972b: 172.

**New Records:** Elliston Bay (outside bar); Investigator Strait (Sta Y5).

**Description:** The colonies are formed of the usual long club-shaped lobes joined basally. Each lobe is composed of a single zooid covered by its own separate sheath of sand-

stiffened test. There are 9-11 rows of 27-28 stigmata, each row crossed by a parastigmatic vessel. A pointed papilla is present in the middle of each primary transverse and parastigmatic vessel on both sides of the body. The internal wall of the stomach is arranged in longitudinal and transverse glandular ridges rather than folds.

**Ritterella herdmania** Kott, 1972a: 41 (synonymy); 1972b: 172; 1972c: 246.

**New Record:** Elliston Bay (outside bar).

#### FIG. 1

**Description:** The present colonies are smaller than usual and sometimes each lobe contains only a single zooid. The lobes are the usual spatulate, long, narrow-stemmed form. Each zooid has 5 rows of about 5 stigmata but there are no parastigmatic vessels, and a single papilla is present in the middle of each transverse vessel. There are only single rows of testis follicles in the posterior abdomina. There are 1-4 embryos in the peribranchial cavity.

**Larvae** are very small, 0.3 mm long. They have 3 median ampullae that alternate with the papillae, and double rows of vesicles that extend around the anterior aspect of the larvae on either side of the papillae and ampullae and extend posteriorly along either side of the dorsal mid line. There is also a paired series of vesicles that extends postero-ventrally (Fig. 1).

**Remarks:** This species has been taken from Elliston Bay (Kott 1972b) in May 1971, and the present colonies were collected in the previous February. Only the latter are sexually mature and contain larvae. It is not clear whether the colonies taken in May were newly settled forms, yet to reach reproductive maturity, or whether they were older colonies that reproduced earlier in the year. However, the species appears to reproduce sexually at the end of summer. Collections from Port Hacking, N.S.W. (Kott 1972c) indicate that there, although new lobes were being added to the colonies at the end of August, the species disappeared during the summer and did not return until autumn. Recolonising stock must therefore exist off Port Hacking, which reproduces sexually at the end of summer or early autumn, i.e. a similar seasonal cycle to that occurring at Elliston Bay.

#### PATRIDIUM n. gen.

Zooids completely embedded with both apertures opening separately to the exterior and without colonial systems. Internal longi-

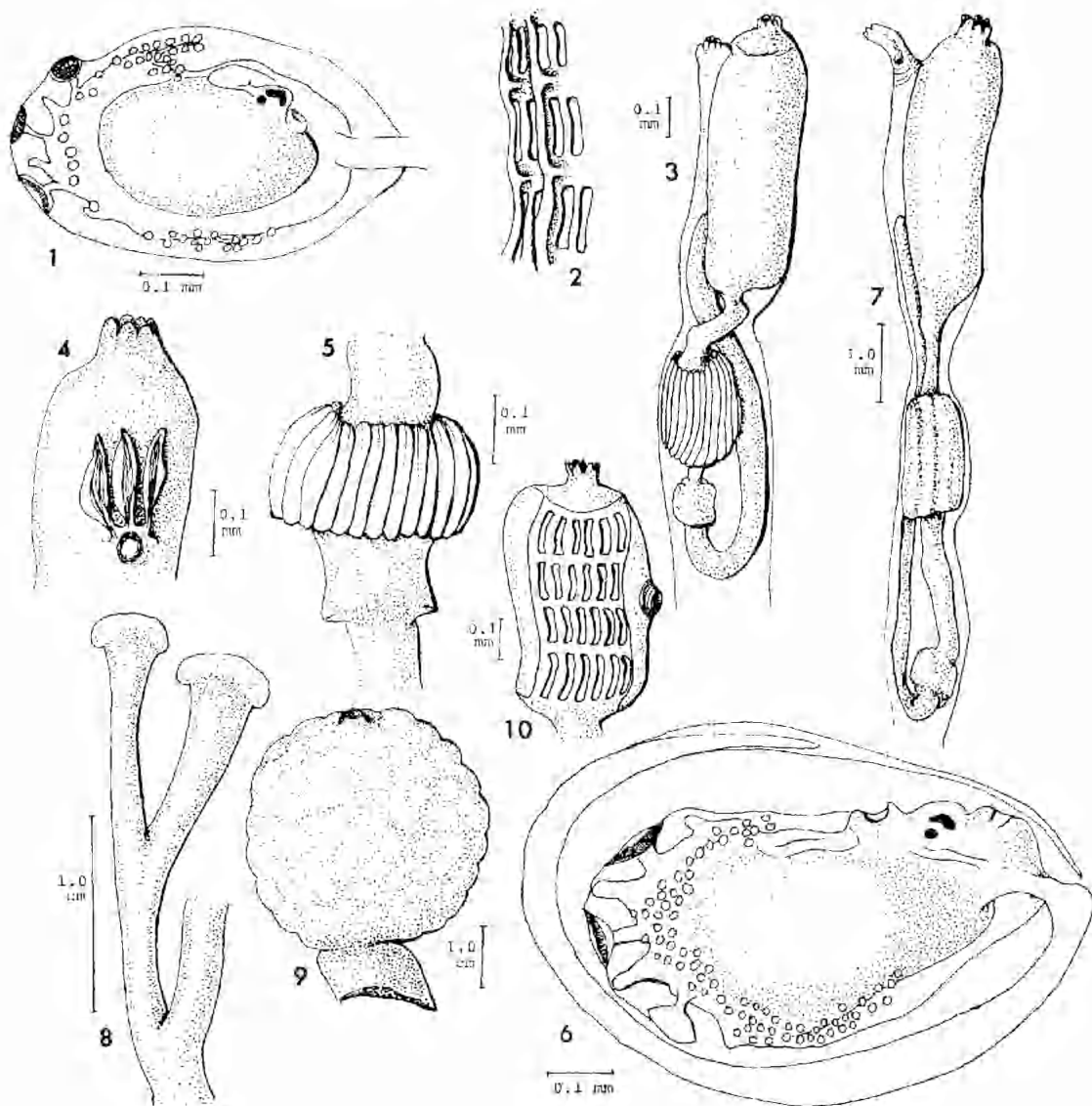


Fig. 1. *Ritterella herdmania*. Larva.  
 Figs 2-3. *Patridium pulvinatum*. Fig. 2.—Portion of branchial sac showing internal longitudinal vessels. Fig. 3.—Thorax and abdomen of adult zooid.  
 Figs 4-6. *Aplidium foliorum*. Fig. 4.—Dorsal aspect of interior portion of thorax showing tripartite atrial lip. Fig. 5.—Stomach. Fig. 6.—Larva.  
 Fig. 7. *Aplidium pronum*. Thorax and abdomen of adult zooid.  
 Fig. 8. *Aplidium digitatum*. Portion of colony.  
 Figs 9-10. *Leptocliudes volvus*. Fig. 9.—Colony. Fig. 10.—Thorax.

tudinal vessels are present in the branchial sac. The stomach is folded. Gonads are present in the thread-like posterior abdomen, the testis follicles arranged in a double row and the ovary present just anterior to the testes. The heart is a U-shaped tube at the distal end of the posterior abdomen.

*Remarks:* Only two genera of the subfamily Euherdmaniinae are known in which either longitudinal vessels or their vestiges are retained in the branchial sac. These genera are *Tylobranchion* Herdman, a monotypic endemic antarctic genus (see Kott 1969), and *Protopolyclinum* Millar, in which 3 species are known,

viz. *P. pedunculatum* Millar, 1960, from New Zealand; *P. sabulosa* (Millar, 1963), from Port Phillip, Victoria; and *P. claviforme* Kott, 1963, from Eden, N.S.W. *Tylobranchion* retains some primitive characters in the presence of the heart half way down the posterior abdomen, and a large ovary posterior to the bunched testis follicles. In *Protopolyclinum* the stomach does not have longitudinal folds and the testis follicles are bunched in a short posterior abdomen as in *Polyclinum* spp. The present genus bears the same relationship to *Aplidium* as *Protopolyclinum* bears to *Polyclinum*. It differs from both *Protopolyclinum* and *Polyclinum* in the presence of stomach folds and in its long thread-like posterior abdomen in which the testis follicles are arranged in rows; it is these characters that relate it to *Aplidium*. It differs from *Ritterella*, also in the subfamily Euherdmaninae, in the presence of the longitudinal vessels, and the absence of parastigmatic vessels in the branchial sac. *Ritterella* is usually further distinguished by the presence of 5 primary rows of stigmata, although these are often subdivided by parastigmatic vessels. The restricted number of primary rows of stigmata suggests that *Ritterella* may be more specialised than *Patridium*, which demonstrates primitive affinities in the presence of a large number of rows of stigmata as well as in the retention of the inner longitudinal vessels.

***Patridium pulvinatum* n. sp.**

*Type Location:* northern Great Australian Bight (32°24'S, 133°30'E), 42 m deep, 5.v.1973. *P. Symond.* *Holotype:* SAM, E 1035.

**FIGS 2, 3**

*Description:* The holotype only is available. It is a circular cushion, 6 cm in diameter and 2 cm high, more or less flat topped and with rounded borders. It appears to have been sessile and attached by a small area in the centre of the basal surface although there could have been a short stalk in this position. The test is very soft and semi-transparent, generally without sand or other adherent foreign particles except for a small sandy area at one side of the basal surface. The zooids are thread like, the thorax and abdomen together are 1.5 mm long and the posterior abdomen about 4 mm. They open all around the upper surface and the posterior abdomina project down into the centre of the colony. The apertures are both 6-lobed. Fine longitudinal muscle bands extend along

both sides of the zooid for its whole length. There are about 25 rows of 16 short, oval, stigmata; rather tall papillae are present on the transverse vessels and these support longitudinal vessels running the whole length of the branchial sac. The longitudinal vessels are crowded, being separated from one another by an interval equivalent to the width of about one and a half stigmata. The oesophagus is fairly long and there is a voluminous stomach about halfway down the abdomen with 25 conspicuous longitudinal folds. The proximal part of the posterior abdomen does not contain gonads but this region is often contracted. The ovary is present just anterior to the double row of testis follicles that occupy the greater part of the posterior abdomen. The heart is a wide U-shaped tube in the distal tip of the posterior abdomen.

***Pseudodistoma cereum* Michaelsen, Kott, 1972a: 12 (synonymy); 1972b: 173.**

*New Record:* Margaret Brock Reef (Cape Jaffa).

*Remarks:* Specimens in the present collection measure up to 12 cm of which the pointed or rounded head represents half of the total length. The zooids, opening all around the head, are small, the contracted thorax and abdomen together measuring only 2 mm (Kott 1972a, 2 cm sic.).

**Subfamily POLYCLININAE**

***Polyclinum neptunium* Hartmeyer, Kott, 1972b: 175 (synonymy).**

*New Record:* Investigator Strait (Sta Y11).

*Description:* The present colonies are small, with rounded heads only about 3 mm in diameter on thin, branching stalks. Each head contains about 6 zooids surrounding a central common cloacal opening. The test is very delicate. There is no sand internally but externally there is a heavy encrustation.

The zooids are minute. The atrial lip is typical of the genus (Kott 1963) and has 4 longitudinal muscle bands. It arises from above the upper rim of the opening and appears to close down over the aperture which is produced to point directly anteriorly. There are 7 muscle bands radiating from the branchial aperture but these do not extend onto the posterior part of the thorax. There are 5-8 small oval stigmata in each of the 7 rows, and papillae on the transverse vessels coincide with the stigmata. The gonads are not developed. The stomach is smooth.



**Remarks:** Although the number of muscle bands in the atrial lip, and the number of rows of stigmata and the number in each row, are very much less than that usually reported for this species, the arrangement of the branchial papillae is the same as that usually reported (Kott 1972b), and it is possible that the colonies are juveniles.

***Aplidium foliorum* n. sp.**

**Type Location:** northern Great Australian Bight (32°24'S, 133°30'E), 42 m deep, P. Symond, 5.v.1973. **Holotype:** SAM, E 1036.

FIGS 4-6

**Description:** The colony is a circular cushion 6 cm in diameter and 2 cm high, forming a low dome, slightly concave basally where the zooid bearing surface layer of the test on one side has grown around onto the basal surface to form a crescent shaped pocket invaginated towards the border of the colony where the surface zooid bearing layer of test has grown to overlap it. The test is soft, gelatinous and semi-transparent. There are about 8 common cloacal apertures scattered over the surface of the colony, about 1.5 to 2 cm apart. Canals radiate out from the openings, lined on each side by rows of zooids. These radiating canals subdivide many times and zooids lining them on each side crowd the test. Zooids are at right angles to the upper surface.

The branchial aperture is terminal with the opening surrounded by a circular sphincter. The atrial lip rising from the upper border of the aperture is very variable and may be simple or tripartite, while the lobes may be large and foliate or small and pointed. There is a band of muscles down the centre of each atrial lobe. There are 14 rows of about 15 stigmata. The stomach is large with 18 to 25 narrow longitudinal folds.

The zooids are long and thread-like, the posterior abdomen comprising the great part of their length while the thorax and abdomen together are only 2 mm long. There are one or two embryos at very different stages of development in a brood pouch that is formed by an expansion of the distal end of the oviduct at the postero-dorsal end of the thorax. Dense testis follicles are present in two rows in the posterior abdomen. The ovary is present anterior to the testis (in the usual position for this genus).

**Larvae:** The larvae are 0.75 mm long with a long tail that completely encircles the body. There are the usual three anterior papillae

alternating with two median ampullae. Numerous ampullary vesicles rise from the lateral ridges extending anteriorly along both sides of the endostyle and to the post ventral aspect of the larval body.

**Remarks:** The species is distinguished from *Aplidium pliciferum* by the larger size of the colony, the very distinct radiating double rows of zooids which comprise the systems, and by the characteristic foliaceous muscular atrial lobes that are present on many of the zooids. The colony does resemble that of *A. australiensis* which has similar systems and in which the branchial sac is the same. In *A. australiensis*, however, there is a lesser number of stomach folds and they are sometimes irregular and oblique, while the zooids lack the distinctive atrial lobes of the present species. The larvae of *A. pliciferum*, *A. australiensis* and the present species are, however, identical. There are slight variations in size (e.g. larvae from the holotype of *A. australiensis* are 0.9 mm long) and in the length of the tail which extends from half to the entire distance around the body. However, the relationship of the length of the tail to the larval body does not appear to be constant for any single species. The characteristic atrial lobes of the present form are similar to those described for *A. elatum* Kott, 1972b, which however differs considerably from the present specimen in colony form.

***Aplidium flavolineatum* (Sluiter) Kott, 1972b: 176 (synonymy).**

**New Record:** northern Great Australian Bight.

**Description:** The colony is mushroom shaped, 4 cm in diameter across the flat upper surface and 2 cm high. The flattened zooid-bearing head narrows very suddenly to a short stalk from the centre of the under surface. Sand is present on the stalk and, to a lesser extent, on the upper surface. The test is clear and glassy but soft. The zooids are crowded in the test and it was not possible to distinguish the form of the systems. Zooids open only onto the upper surface. They are 6 mm long, of which the thorax is 2 mm and abdomen only 1 mm. The posterior abdomina cross one another in the internal test although the thoraces are parallel at the surface. The atrial lip is divided into 3 very pointed lobes from the upper border of the opening. There are 12 fine longitudinal muscles on the thorax. There are 12 rows of 10 long rectangular stigmata. The stomach is

especially small with 17 distinct longitudinal folds. There are 2 rows of testis follicles in the posterior abdomen.

**Larvae:** Up to 5 developing embryos are present in the atrial cavity. They are 0.75 mm long, have 3 median papillae alternating with single median ampullae and corresponding lateral ampullae develop from the lateral ridge. The median ampullae are narrow and in some cases appear to be bifurcated. There are also clusters of ampullary vesicles both above the endostyle and ventral to the body of the larva. The tail winds about three quarters of the way around the body of the larva.

**Remarks:** The colony and zooids are of similar form to those described previously for *A. flavolineatum* with the exception of the stomach in which there are only 17 folds. The size and shape of the stomach and the course of the longitudinal folds are similar to those described previously for this species.

***Aplidium coniferum* Kott, 1963: 102.**

**New Records:** Elliston Reef. **Previous Records:** N.S.W. (near Twofold Bay, 10–70 m deep; Montague North, 13 m deep)—Kott 1963.

**Description:** Sessile, rounded lobes about 4 cm in greatest diameter. The test is sandy internally, but the external layer of test is free of sand and is smooth and gelatinous. Zooids are long and narrow and open all around the head. There is a small pointed atrial lip from the body wall anterior to a muscular siphon that is present about one third of the distance down the dorsal surface. The thorax is long and narrow with about 15 rows of 10 stigmata. There are 5 stomach folds.

**Remarks:** The specimen agrees with those previously described. The clear external layer of test without sand and the form of the colony are apparently characteristic of the species.

***Aplidium amorphatum* Kott, 1963: 101.**

**New Record:** Elliston Bay. **Previous Record:** Vic. (38°51'S, 146°55'E)—Kott 1963.

**Description:** The colony is soft, sessile and dome shaped. The test is semi-transparent, without sand. Zooids open all around the upper surface and no systems are evident. The zooids are very small and irregularly oriented in the test so that they cross one another. There are 10 longitudinal thoracic muscles. The atrial aperture is on a short siphon. The upper rim of the aperture is produced into a pointed lip.

There are 12 rows of about 10 stigmata. Each row is crossed by a parastigmatic vessel. The stomach is small with 5 folds.

**Larvae:** The atrial cavity is occupied by a single large embryo, 1 mm long. It has the usual 3 median, stalked, papillae and numerous ampullary vesicles are developed from the anterior part of the body.

**Remarks:** The specimen is identical with that previously described for the species. The larva is the same as that of *A. pantherinum* (see Kott 1963). The shape and consistency of the colony differ, however, and resemble *A. protectans* (Herdman); Kott 1963. In the latter species, however, the zooids are larger, the branchial sac larger, there are more thoracic muscle bands and the parastigmatic vessels are not present.

***Aplidium prorum* n. sp.**

**Type Location:** Investigator Strait (Stn X1), 9 m deep, Watson, Jan. 1971. **Holotype:** NMV. H 287.

**FIG. 7**

**Description:** The colony consists of small, flat-topped lobes united basally. The test is soft and there is very little sand internally. There is a single common cloacal aperture in the centre of each lobe. The zooids are more than 1 cm long and thread-like. The thorax and abdomen are of equal length, and about one third of the total length of the zooid. The atrial lip is bifid or trifid terminally and extends from the upper border of the atrial opening which is on a short siphon. There are 11 rows of 12 stigmata and 8 very weak stomach folds. There are 20 longitudinal thoracic muscles.

**Remarks:** The colonies resemble those of *A. novaezelandiae* Brewin and *A. cottrilli* (Brewin) from New Zealand, although the flat-topped lobes. Brewin (1952, 1957 respectively) described for both these species have several systems, only 5 stomach folds, and the atrial siphon is not produced. The atrial siphon of *A. maritimum* (Brewin, 1958a) is, in fact, produced in the same way as in the present species, and the stomach has the same ill-defined folds. However, the longitudinal thoracic muscles are more plentiful in the present specimens, there are fewer stigmata in each row, the posterior abdomen is longer and more thread-like, and there is only a single system in each lobe. Further, in Brewin's species the lobes are separate and do not appear to be con-

tinuous in their basal half as in the present species.

***Aplidium digitatum* n. sp.**

*Type Location:* northern Great Australian Bight (32°24'S, 133°30'E), 49 m deep. 5.v.1973. *P. Symond.* *Holotype:* SAM, E 1030. *Paratypes:* QM, G 7508; AM, Y 1982.

FIG. 8

*Description:* The colonies are long, branched, cylindrical stalks 2–3 cm long, terminally rounded and slightly expanded to overlap the stalk. The zooids open onto these terminal expansions. Sand is absent only from the surface test where the zooids open on the expanded terminal portion of the lobes. The stalk is densely encrusted with sand. The test is firm, especially in the stalk, and is impregnated with sand throughout. Zooids are minute, but long and thread-like, crowded in the test and extending parallel to one another down the stalk. There are 15 rows of about 8 stigmata. There is a long, pointed, atrial lip from the upper border of the opening. The stomach has 12 longitudinal folds. There is a double row of testis follicles in the long posterior abdomen. There is a large common cloacal opening in the centre of each lobe.

*Remarks:* The colonies resemble those of the Antarctic species *Aplidium recumbens* Kott, 1969, but are distinguished by the large number of distinct longitudinal folds in the stomach. The zooids are especially delicate and narrow.

***Aplidium colelloides* (Herdman). Kott, 1972b: 176 (synonymy).**

*New Record:* northern Great Australian Bight.

Family DIDEMNIDAE

***Polysyncrator aspiculatum* Tokioka, 1949: 2. Kott, 1962: 301.**

*Polysyncrator magnilarvum* Millar, 1961: 13 (*nomen nudum*); 1962: 165. Kott, 1972b: 178.

*New Records:* northern Great Australian Bight; Investigator Strait. *Previous Records:* W. Aust. (Rottneil I., Pt. Peron)—Kott 1962. S. Aust. (Investigator Strait)—Kott 1972b. Qld (Mackay)—Kott 1962. S. Africa—Millar 1962. Mozambique—Millar 1961. Japan—Tokioka 1949.

*Description:* The colony from the Great Australian Bight is a soft jelly-like cushion. The

common cloacal system consists of narrow canals at oesophageal level, radiating from common cloacal apertures and lined on either side by zooids. There are no spicules. The zooids are of moderate size, with 4 rows of stigmata and a long bifurcated atrial tongue. The oesophageal neck is long. Gonads are not mature.

The colony from Investigator Strait (that is doubtfully assigned to this species) consists of 2 large flattened lobes rising from a fleshy cylindrical common basal stalk. The zooids are embedded in the surface layer of test. The common cloacal canals extend between clumps of zooids beneath an especially thin layer of surface test. There are very extensive cloacal spaces between the central, soft test that forms the central core of each lobe and the surface that is only occasionally joined with the central core by solid test connectives. Secondary canals extend between the zooids beneath a very thin layer of surface test. The test is colourless and transparent, and the zooids show through it as white dots. There are no spicules. Zooids have a long oesophageal neck, and the usual 4 rows of stigmata. Gonads are not mature in this colony.

*Remarks:* Specimens assigned to both *P. aspiculatum* Tokioka, 1949 and *P. magnilarvum* Millar, 1962, are soft and rounded, stalked or sessile, from 3 to 7 mm thick, with variable spicule distribution to an aspicular condition. The atrial lip is long, and often spread or bifurcate at its tip. There are also, in both, a large number of testis follicles (8–12) and large larvae (over 1 mm long) with up to 15 pairs of lateral, finger-like ampullae and precocious buds. Zooids of both species are also characterised by a long oesophageal neck. In Australian specimens the ventral surfaces are embedded in the common test and they are arranged along both sides of common cloacal canals that demarcate rounded zooid-free swellings of the surface of the colony. In neither species has the common cloaca been described as posterior-abdominal. The shape of the present colony from Investigator Strait is identical with others from this area that are assigned to *P. aspiculatum* (>*P. magnilarvum*; Kott 1972b). The posterior abdominal cavities in this colony, however, do not occur in those previously described. Positive identification is not possible owing to the lack of mature gonads, and the relationship of the extensive cloacal system with the simple canals that have been

previously described is not known. The cloacal system is the same as that of *Didemnum lam-bitum* and *Polysyncraton chondrilla* but both these species have only a single aperture and are not known without spicules.

***Leptoclinides volvus* n. sp.**

*Type Location:* northern Great Australian Bight (32°24'S, 133°30'E), 42 m deep. *P. Symond*. *Holotype:* SAM, E 1034. *Para-types:* SAM, E 1033; QM, G 7511.

**FIGS 9, 10**

*Description:* The specimen designated as the holotype is a flattened sphere 5.0 cm in diameter and 3 cm thick, with a thick but very short stalk, constricted to 2 cm in diameter where it joins the body. The paratypes are entirely spherical, about 3 cm in diameter, and are without stalks although the base of the colony is identified by the absence of zooids and by foreign matter that is included in the test material which has overgrown the area. There is a single, apical, sessile, and inconspicuous common cloacal aperture, opposite the base of the colony at the junction of several common cloacal canals. Zooids are arranged along both sides of narrow cloacal canals at the abdominal level of the zooids and the surface of the colony is depressed above these canals. These depressions demarcate rounded swellings of the surface of the test corresponding to zooid-free areas. The test is very firm gelatinous and translucent. There is a layer of bladder cells superficially. A sparse layer of spicules is present in the zooid layer of test and these are most dense around the zooids, thus indicating their position through the test. The spicules are minute, 0.015 to 0.02 mm in diameter, some stellate and others with needle-like rays. There are minute, spherical, brown, pigment cells scattered throughout the test. Zooids are small, with about 8 stigmata per row. The branchial siphon is of moderate length. The atrial siphon is very short, rising from the mid dorsum, opposite the space between the second and third rows of stigmata. It is surrounded by a circular sphincter muscle and is posteriorly or laterally directed. There are 5½ coils of the vas deferens and up to 10 testis follicles. Large ova are present in the test at abdominal level but none of these appear to be developing embryos.

*Remarks:* The spherical body, constricted stalk and single common cloacal opening are unusual in this genus. The lack of stalk in the two para-

types, together with the spherical shape, suggest that these colonies may be free living, although the foreign particles that are embedded in the basal region suggests that this part of the colony was fixed to the substrate, broke free and was overgrown by the surface test. The constriction where the broadening stalk joins the head in the holotype also supports the suggestion that the spherical head may break away. Certainly the configuration of the surface, with the projecting swellings of solid gelatinous test, while the zooids, their openings, and the common cloacal aperture are depressed into the surface of the test, would all accommodate a free living habit in which the colony is able to roll over the sea floor as in some coral species (see Glynn 1974, Pichon 1974).

The limited nature of the common cloacal system is unusual in this genus where extensive posterior abdominal spaces are usually developed. It differs from species in other genera, in which the zooids are arranged along both sides of narrow common cloacal canals that extend around circular zooid-free areas, in that the canals are at the abdominal rather than the thoracic level (see *Polysyncraton aspiculatum*, above; and *Didemnum patulum*, Kott 1972a).

Stalked species are also unusual in this genus, *L. fungiformis* Kott, 1972b being the other that is known. It is distinguished from the present species by its undivided testis follicle.

***Leptoclinides reticulatus* (Sluiter), Kott, 1962:** 285 (synonymy); 1972a: 18; 1972b: 180.

*New Record:* northern Great Australian Bight.

*Description:* A large colony, investing a specimen of *Herdmania momus*. There are streaks of orange-brown, stellate, pigment cells scattered amongst the spicules in the surface test. The spicules have 7 rays in optical transverse section and are 0.03 to 0.05 mm in diameter. There is a superficial layer of bladder cells mixed with spicules. Spicules are dense at the zooid level but are absent basally, below abdominal level. Common cloacal canals were not found and the thoraces of the zooids appeared to be partially disintegrated although the abdomina were in good condition with 5½ coils of the vas deferens around 5 to 9 testis follicles. Small vegetative buds are present in the oesophageal region.

*Remarks:* The absence of common cloacal canals and the condition of the zooids suggests that the colonies may present a quiescent winter



condition. The presence of vegetative buds and mature gonads suggests the onset rather than the end of this quiescent phase.

**Leptoclinides rufus** (Sluiter). Kott, 1962: 286 (synonymy); Eldredge, 1967: 221.

*Leptoclinides lissus*; Millar, 1963: 704.

*New Records*: Elliston Bay (outside bar, and 25 m deep). *Previous Records*: S. Aust. (Port Noarlunga). Tas. (Marla I.). Vic. (Shoreham).—Kott 1962. N.S.W. (Port Jackson)—Kott 1962, Millar 1963. Qld (Barragatta, Heron I., Low Isles)—Hastings 1931; Kott 1962. Indonesia (Paternoster I., Arafura Sea)—Sluiter 1909, 1913; Tokioka 1952, New Zealand (North Island)—Michaelsen 1924; Brewin 1958b; Millar 1960. Hawaii (Oahu)—Eldredge 1967.

*Description*: Living colonies are reddish brown or grey with orange around the siphons. They are firm and investing, with common cloacal openings in the centre of evenly spaced rounded swellings. The common cloacal apertures are about 1 cm distant from one another. There is a surface layer of bladder cells and spicules are especially dense below this layer. They gradually become less dense and are absent altogether from the basal half of the colony. Although they are present in a layer at the base of the common cloacal cavity, they are stellate, 0.02 to 0.04 mm in diameter with pointed conical rays. The spicules are especially densely accumulated around lobes of the branchial apertures.

The common cloacal cavity is posterior abdominal, extending into circular chambers beneath the common cloacal apertures.

The zooids are about 2 mm long with up to 12 longitudinal thoracic muscle bands from which fibres branch and anastomose with adjacent bands. There is a minute circular lateral organ opposite the 4th row of stigmata. The atrial aperture is directed posteriorly as is usual for the genus. There are up to 10 stigmata in each row. The oesophagus is long. The gut loop may be curved, although it also occurs as a long straight loop. The gut is clearly differentiated into duodenal and mid intestinal regions and a posterior stomach swelling. The stomach is smooth and rounded, longer than its diameter. There are 9 to 10 testis follicles and 7½ coils of the vas deferens.

*Remarks*: The synonymy of *L. lissus* Hastings, from Low Isles, with *L. rufus* originally described from Indonesia and the Arafura Sea to

the north, within the same biogeographical region, was arrived at after comparison of Hastings type material (AM. G 13449) with other specimens from a wide range along the southern and eastern Australian coast, including the Great Barrier Reef and the Queensland mainland. The type specimen of *L. diemenensis* has not been examined, although Tokioka (1952), Millar (1960), and Kott (1962) have not been able to identify any character that could distinguish the two species. Its synonymy with *L. rufus* is here maintained. The range of *L. rufus* is, therefore, similar to that of many wide ranging species of this family in both tropical waters (Kott 1974) and in Antarctic waters (Kott 1969a). The other related New Zealand species, *L. sluiteri*, *L. auranticus* and *L. novae-zelandiae*, are distinguished only by the larger number of coils of vas deferens, the relatively shorter oesophagus and the smaller zooids. Further specimens are needed to adequately determine the parameters of each of these species. *L. rufus* is characterised by its relatively large zooids with distinct longitudinal thoracic musculature but no retractor muscle; by its long oesophagus and gut loop and the clearly demarcated gut regions; by its long and muscular siphons; by the invasion of spicules into the superficial bladder cell layer and by the position of the small lateral organ in the posterior part of the thorax. The number of testis lobes in the present specimens is greater than the maximum of 7 previously recorded.

**Didemnum candidum** Savigny, Kott, 1972a: 19 (synonymy); 1972b: 179.

*New Record*: northern Great Australian Bight.

**Didemnum moseleyi** (Herdman), Kott, 1972a: 19 (synonymy); 1972b: 179.

*New Record*: northern Great Australian Bight.

**Trididemnum savignii** (Herdman) s. sp. *savignii* Herdman, Kott, 1966: 285 (synonymy); Eldredge 1967: 179.

*New Record*: Sellick Beach (south of Adelaide), S. Aust.

*Description*: Extensive investing colony with round, smooth, margins. There is a spicule-free surface layer of bladder cells. Spicules are sparse in the zooid layer and are absent altogether from the basal half of the colony. The common cloacal canals are deep, extending the whole length of the zooids, but they are not

posterior abdominal. The spicules are 0.04–0.08 mm in diameter. They are stellate with 12 conical rays in optical transverse section. The zooids are surrounded by black pigment particles that are often but not always accumulated into the usual pigment patch at the anterior end of the endostyle. There is a distinct atrial siphon which is laterally rather than posteriorly directed in these colonies. There is a distinct retractor muscle. The testis is not mature and the vas deferens was not distinguished.

**Remarks:** No further evidence is available from the examination of these specimens that could clarify the relationship between this Indo-Pacific subspecies and the Atlantic Ocean form *T. savignii* subsp. *atrocanum* Van Name (see Kott 1966). It should be noted that the Pacific Ocean specimens (Eldredge 1967) have the 7–8 coils of the vas deferens that is associated with the Indo-Pacific form (Kott 1966).

**Trididemnum cerebriforme** Hartmeyer, Kott, 1972c: 47 (synonymy).

*Trididemnum savignii*; Tokioka, 1967: 80; var. *jolense*: 82.

**New Record:** Sellick Beach (south of Adelaide), S. Aust.

**Description:** The colonies are investing and of variable thickness. Conspicuous common cloacal apertures with frilled lips are distributed randomly over the surface of the colony. Posterior abdominal cloacal canals radiate from these apertures. Spicules are sparse in the upper layer of test and apart from a layer lining the test along the floor of the common cloacal cavity, they are entirely absent from the basal layer of test. The spicules are stellate, 0.02 to 0.04 mm in diameter, with about 6 rays in optical transverse section.

The body wall of the thorax is covered with black pigment particles although these are absent from the abdomen. The pigment particles are accumulated in a patch over the anterior end of the endostyle. The atrial siphon is posteriorly directed. There are 6½ coils of the vas deferens around an undivided testis follicle.

**Remarks:** The relationship of this species to *T. savignii* is perplexing since its three-dimensional common cloacal system provides the principal distinction. *T. cerebriforme* acquires great complexity in its common cloacal system with growth, but juvenile colonies must necessarily display a cloacal system identical with that of *T. savignii* before its subsequent proliferation,

as the colony thickens and surface folds develop. In the present specimens, both taken from Sellick Beach, each species has spicules of different sizes although this size difference was not observed in specimens previously described. The number of spicule rays as previously reported, however, is greater for *T. savignii* than for *T. cerebriforme*.

**Diplosoma translucidum** (Hartmeyer)

*Leptoclinum* (*Leptoclinum*) *translucidum*; Kott, 1962: 306 (synonymy).

**New Record:** Investigator Strait (Sta X1).

**Previous Records:** Indonesia—Sluiter 1909. North Western Australia—Hartmeyer 1919. W. Aust. (Oyster Harbour, Albany)—Kott 1962.

**Description:** The colony is irregularly lobed, investing weed or other ascidians. Each lobe is flattened, about 2 cm wide, 0.5 cm thick and up to 3 cm long. One colony completely envelops a specimen of *Pyura australis* in which only the apertures are exposed. The surface is smooth, and the zooids show through as white dots. They are small and crowded at the surface of the colony in groups of about 8.

There is a large ovum present in most zooids but the testis is not mature and no coils of the vas deferens were detected.

**Remarks:** The tough, firm transparent test and the extensive cloacal system is characteristic of this species.

#### Family ASCIDIIDAE

**Ascidia thompsoni** Kott; 1972a: 27 (synonymy); 1972b: 181.

**New Records:** upper Spencer Gulf.

**Description:** Specimens have a gelatinous test, sometimes thick and furrowed. Both apertures are present on siphons, usually both directed dorsally or anteriorly and sometimes very long. The animal is fixed ventrally and by most of the left side. There is sometimes a coating of sand encrusting the body, but sand is never present on the siphons. The body wall has the usual meshwork of muscles on the right side of the body. The anterior part of the dorsal lamina is a double membrane, ribbed on the outer sides but not in the centre. The ribs of the dorsal lamina extend into pointed projections on the free edge of the membrane.

The neural ganglion is about one-third of the body length from the dorsal tubercle.

**Remarks:** The specimens from Station D3 on the floor of the channel are encrusted with a

layer of sand absent only from the siphons which project upward from the middle of the upper surface. In this specimen, the right side of the body is narrower than the left and comprises the right side of the upper surface, while the base, by which the animal is fixed, is the ventral surface and a large part of the left side of the body. In specimens from G4, also on the floor of the channel, the siphons are especially long, both directed upwards, and the right side of the body is similarly short.

The very long external siphons directed upwards, and the sand encrustation, are unusual in this species. *Ascidia aelara* is the only species of the genus in which a similar sand encrustation hardens the test. The long, cylindrical extensions of the test that, in *A. aelara*, create a canal or tube from the sessile apertures extending upwards from the animal, are analogues rather than the homologues of the long siphons in the present forms. It is also of interest that, in specimens from stations D3 and K4, where the siphons extend dorsally, their central position, from the middle of the upper surface of the body, is achieved by relative narrowing (i.e. between the dorsal lamina and the endostyle) of the right side of the body; whereas in *A. aelara* it is the left side of the body that is narrower than the right. The base of the present specimens is the ventral and two-thirds of the left surfaces of the body, while in *A. aelara* it is two-thirds of the right side, between the dorsal lamina and endostyle (Kott 1972d).

The specimens appear to have adapted to their free existence on a shifting sandy sea floor by these morphological variations in the position and length of the siphons.

*Ascidia aelara* Kott, 1972d: 236 (synonymy).

*New Record:* Goat I. (off Ceduna).

#### Family STYELIDAE

*Stolonica carnosa* Millar, 1963: 734. Kott, 1972a: 28.

*New Record:* Investigator Strait (Stn Y1).

*Remarks:* The present specimens are small and sandy individuals joined by stolons. There are only 3 stigmata per mesh and the longitudinal vessels in the branchial sac are slightly fewer than previously reported, viz. DL0(5)2(4)1E. It is probable that this is a young colony, which is characterised by a pyriform stomach with narrow folds and a long curved caecum that extends into the gut loop from the suture along the lateral aspect of the stomach.

*Amphicarpa diptycha* (Hartmeyer). Kott, 1972e (synonymy).

*New Record:* northern Great Australian Bight.

*Oculinaria australis* Gray, Kott, 1972a: 29 (synonymy); Kott, 1972b: 184.

*New Record:* Elliston Bay.

*Symplegma viride* Herdman, Kott, 1952: 252 (synonymy); 1962: 129. Millar, 1966: 368. Plante & Vasseur, 1966: 149. Tokioka, 1967: 162 (synonymy). Vasseur, 1967: 111.

*New Record:* Elliston Reef.

#### Subfamily BOTRYLLINAE

#### PARABOTRYLLUS n. gen.

Colonies are elongate branching stalks slightly expanded terminally. One to 3 circular systems of zooids are present in each terminal expansion, opening onto a more or less flattened surface of each free lobe. Each system of zooids surrounds a central common cloacal aperture. The terminal ampullae and conspicuous blood vascular system that are present in other genera of this subfamily are absent. The rim of the branchial aperture is smooth. The atrial aperture has a single anterior lip. There are only 2 internal longitudinal vessels in the branchial sac. Eggs are endogenous.

*Remarks:* The zooids are not conspicuously different from those of the genera *Botryllus* and *Botrylloides* except in the presence of only 2 internal longitudinal vessels in the branchial sac. The colony differs considerably, however, both in its shape, and in the presence of only one to three systems opening onto the flat terminal surface of each lobe. Buds are present in the common test near the posterior region of the adult zooids, to which they are joined by narrow connectives from the oesophageal region of the parent. The buds in this genus therefore do not, apparently, maintain a close connection with the parent until a late stage in their development as they do in other genera of the sub-family. The zooids are endogenous and have three to four developing ova on each side as in *Botryllus*, while *Botrylloides* produce only single ova on each side of the body.

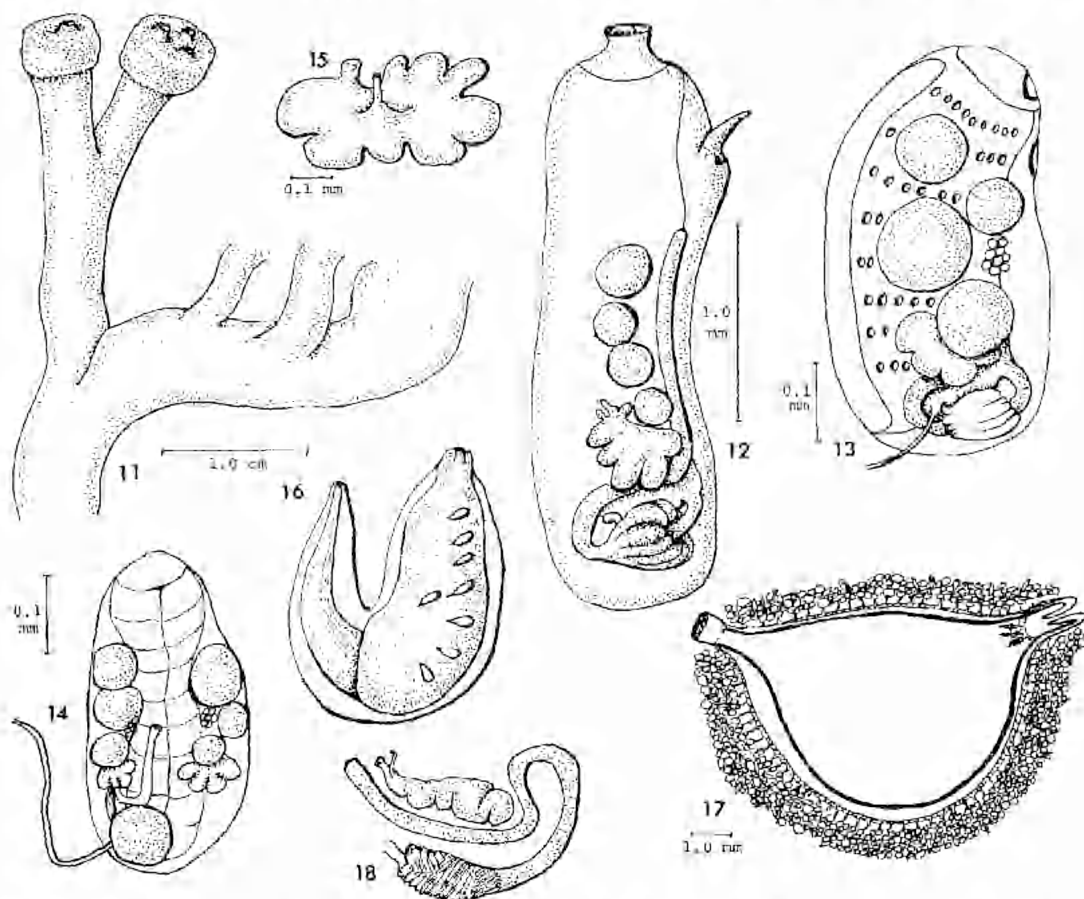
#### *Parabotryllus nemorus* n. sp.

*Type Location:* upper Spencer Gulf (Stn G), 9 m deep, floor of channel. 5.ix.1973. *Holotype:* SAM, E 1031. *Paratypes:* AM, Y 1981; QM, G 7507.

## FIGS 11-15

*Description:* The colonies consist of narrow, sandy lobes, 1-1.5 cm long, usually branched. The superficial layer of test is encrusted with sand but is neither stiff nor brittle. Internally sand is absent and the test is very soft. There are circular systems of zooids opening onto the upper free end of the lobes surrounding the central common cloacal apertures that are slightly depressed into the surface. Generally there is only a single system in each terminal branch of the colony although occasionally there are 1 or 2 smaller additional systems. The blood vessels in the test are short and relatively few for this subfamily. They terminate in elongate rounded bulbs at the base of the zooids. The zooids are about 2 mm long. The rim of the branchial aperture is smooth and the atrial

aperture, in the anterior third of the dorsal surface, has its upper lip produced into a single pointed lip. The atrial aperture is very small and is directed anteriorly so that the upper lip closes over it (as in *Polyclinum*). There are 10 rows of stigmata with about 10 stigmata in each row and two internal longitudinal vessels on each side of the body. The gut forms a single tight loop on the left side of the branchial sac. The stomach is pyriform with about 8 distinct longitudinal folds and there is a short curved caecum, of moderate length and expanded into a terminal bulb, from the pyloric end of the stomach. There is a connective extending from the pyloric region of the stomach to the intestine. There is a single, flat, testis follicle with lobed margins on each side of the branchial sac just anterior to the gut loop.



Figs 11-15. *Parabotryllus nemorus*. Fig. 11.—Portion of colony showing branching stalks. Fig. 12.—Adult zooid. Fig. 13.—Bud (lateral aspect) showing connecting vessel. Fig. 14.—Bud (dorsal aspect) showing endogenous ova. Fig. 15.—Testis.  
 Fig. 16. *Polycarpa tinctor*. Aberrant individual with atrial siphon produced anteriorly.  
 Fig. 17. *Pyura tendata*. Section through the body wall, test and sandy coating.  
 Fig. 18. *Microcosmus planus*. Gut and gonad on left side of the body.



The vas deferens, arising from the middle of the mesial surface of the testis, is very short. There are three or four ova in the body wall anterior to the testis lobe. These are endogenous and project into the peribranchial cavity. Developing buds are present in the test on either side of the posterior end of the adult zooids. These contain four large ova on each side of the body and a clump of large cells dorsal to the ova. It is possible that these may be precociously differentiating buds. The buds at this stage of development are 0.25–0.5 mm long. There is a blood vessel extending from the posterior end of each bud in the region of the oesophagus.

**Remarks:** The species is distinguished from others in the subfamily by the large number of ova and internal longitudinal branchial vessels, the relatively limited blood vascular system in the test, and the form of the colony and the limited development of colonial systems. The internal test is also very soft in comparison with that of other species in the subfamily. The buds appear to undergo the major part of their development in the test in connection with the colonial blood vascular system and in the present colonies there were no buds found directly associated with the parent zooids. The testis of this species is reminiscent of that in *Sympyga*, while the multiplicity of ova resemble *Batryllus* and the endogenous nature of their development and the small circular systems in the colony are also reminiscent of the latter genus.

#### Subfamily STYELINAE

**Polycarpa tinctor** (Quoy & Gaimard). Kott, 1964: 134 (synonymy); 1972b: 186; 1972c: 254; 1972d: 242.

**New Record:** upper Spencer Gulf (Stn B10).

#### FIG. 16

**Remarks:** One of the specimens is highly modified. It has the usual short branchial siphon from the anterior end of the body. The atrial siphon, however, extends anteriorly from the posterior half of the dorsal surface parallel with the anterior half of the body and opens at a point more or less level with the branchial aperture, so that the individual is U-shaped. The lower half of the body is encrusted with large particles of sand but the upper half has only fine sand encrusting it, and it appears that the animal had been half buried in the floor of the channel and that the atrial siphon was pro-

duced upwards so that it opened above the sea floor. In another specimen there are long root-like processes from the ventral border of the body, which is otherwise typical of the species (Fig. 16). In the U-shaped specimen there is a single row (17) of long polycarps around the ventral border of the body and only occasional polycarps, representing a second row, scattered dorsal to these.

**Polycarpa pedunculata** (Heller). Kott, 1972a: 35 (synonymy); 1972b: 186.

**New Records:** upper Spencer Gulf; northern Great Australian Bight; Investigator Strait. For *Previous Records, Description*, see Kott 1972a, 1972b.

**Remarks:** From the upper part of Spencer Gulf, arenaceous and naked specimens are taken, sometimes growing side by side attached to the same shell or stone. There are a large number of specimens and they are either stalked or sessile. Naked specimens with a leathery test were a bright yellow colour in life but pinkish in preservative. Living arenaceous specimens were a sandy colour with a reddish tinge. There are small, smooth, black individuals in the preserved material and some that are larger with rough leathery and rather thin test. In nature such specimens with a smooth test are bright yellow (S. A. Shepherd, pers. comm.).

**Polycarpa papillata** (Sluiter). Kott, 1972a: 34 (synonymy).

**New Record:** upper Spencer Gulf (Stn B7).

**Remarks:** 2 specimens only are available. One is juvenile with a whitish coloured test and without developed polycarps. The other mature individual has a row of eight long polycarps around the ventral aspect of the left body wall, with the ducts directed towards the atrial opening. There are five rounded anal lobes slightly bifurcated and only two polycarps are present in the middle of the right body wall. The specimen otherwise conforms with previous descriptions of this species.

**Styela pedata** (Herdman). Kott, 1972b: 185 (synonymy).

**New Records:** northern Great Australian Bight.

**Styela plicata** (Leseuer). Kott, 1972b: 185; 1972c: 254; 1972d: 239 (synonymy). Tokloka, 1967. Abbott & Johnson, 1972: 95.

**New Record:** Port River (St Vincent Gulf).

**Remarks:** The individuals are small and the rounded swellings of the test are obscured by epiphytic growth. However, the species is readily distinguished by the short vasa efferentia, branched testis follicles, undulating (sometimes branched) ovarian tubes, long oesophagus, long rectum, deep secondary gut loop, long voluminous stomach with internal folds and the small leaf-like endocarps that cover the body wall and the gut loop distal to the stomach.

The gut loop is reminiscent of that of *S. ramificata* (Kott 1972d) although the rectum and oesophagus are longer in the present species; and although the gonads resemble those of *S. partita* (Stimpson), in the present species the oesophagus is shorter and the vasa efferentia are shorter (Vasseur 1967).

**Cnemidocarpa etheridgii** (Herdman). Kott, 1972a: 31 (synonymy); 1972c: 253.

**New Record:** northern Great Australian Bight.

#### Family PYURIDAE

**Pyura tendata** Kott, 1972b: 186.

**New Record:** south of Goat I. (off Ceduna).

#### FIG. 17

**Description:** A single specimen only is available. It is more or less a half circle in outline, one cm in diameter. The external siphons extend from the anterior and posterior ends of the more or less straight dorsal surface. The branchial aperture is directed anterodorsally and the atrial aperture is directed posterodorsally. The external test is covered by a thick coating of sand held in place by hair-like extensions from the test. There is a thin space between the sandy coating and the surface of the test, traversed only by the base of the test hairs. There is also a coating of very fine sand on the surface of the test itself. The apertures are lined with a very tough invagination of the test. The branchial siphon is especially muscular and appears to be eversible. The body wall is also very muscular. The atrial siphon is muscular but not eversible and its aperture is protected by a well developed velum at the distal end of the siphon. Beyond this velum the test is produced into a cylindrical fibrous extension for a short distance. There are seven branchial folds on each side of the body with 14 strong internal longitudinal vessels very closely placed on each fold. There are no internal longitudinal vessels in the interspace

between folds. The branchial tentacles are of varying sizes and twice pinnate. The dorsal lamina is produced in a series of pointed languets. The gut forms a narrow straight loop and there is a mass of branched liver tubules in the gastric area. Gonads are divided into separate paired polycarp-like sacs extending along both sides of the central common duct.

**Remarks:** This specimen agrees in most aspects with those described from Investigator Strait, although the sandy coating is not as thick in the present specimen. Nevertheless, the nature and orientation of the siphons are identical as are the internal organs, viz. the branchial sac, the gut and the gonads. The atrial velum in the specimen from Investigator Strait was present at the base of the atrial siphon rather than more terminally as in the present specimens, and this is possibly related to thickness of the sandy coating. The test beyond the velum is apparently produced to accommodate the thickness of the sand surrounding the animal.

**Pyura pachydermatina** (Herdman) s. sp. **gibbosa** (Heller). Kott, 1972b: 187.

*Cynthia gibbosa* (Heller), 1878: 27.

*Pyura gibbosa*; Michaelsen & Hartmeyer, 1928: 410. Non *P. pachydermatina* var. *gibbosa*; Kott, 1952: 265 (<*P. pachydermatina draschii*; Kott, 1972b: 187).

*Pyura pachydermata* var. *intermedia*; Kott, 1952: 264 (synonymy) (part). Non *P. gibbosa intermedia* Michaelsen, 1922: 391. (<*P. spinifera*; Kott, 1972b: 187).

**New Record:** northern Great Australian Bight. For *Previous Records, Description*, see Kott 1972b (*P. pachydermatina draschii*); 1952 (*P. pachydermatina intermedia*).

**Remarks:** The present specimens have the typical curved spines in the branchial siphon and the anus is bordered with shallow rounded lobes.

**Pyura spinifera** (Quoy & Gaimard). Kott, 1972b: 186 (synonymy).

**New Record:** northern Great Australian Bight.

**Pyura australis** (Quoy & Gaimard). Kott, 1972b: 186 (synonymy).

**New Record:** reef, Douglas Bank (upper Spencer Gulf).

**Pyura scoresbiensis** Kott, 1972a: 36; 1972b: 187.

**New Record:** upper Spencer Gulf (Stns F3, G).

**Pyura vittata** (Stimpson). Kott, 1972a: 37 (synonymy); 1972d: 243.

*New Record:* upper Spencer Gulf (Stn A1).

*Remarks:* The spines lining siphons are typically long (0.1 mm) and needle-like and overlapping. The anal border is smooth and two-lipped.

**Pyura irregularis** (Herdman). Kott, 1972a: 38 (synonymy); 1972b: 187.

*New Record:* upper Spencer Gulf (Stn B7).

*Remarks:* The peritubercular area has the usually blister-like appearance that is characteristic of this species. The large dorsal tubercle, however, is at the top of this area rather than, as has been previously described, at its base. The tough leathery test and strong branchial sac characteristic of this species are present.

**Pyura stolonifera** (Heller) s. sp. *praeputialis* Heller. Kott, 1952: 274 (synonymy); 1964: 141.

*Pyura praeputialis:* Millar, 1966: 372.

*New Record:* Outer Harbour (St Vincent Gulf). For *Previous Records and Description* see Kott, 1952; Millar, 1966.

*Remarks:* This location apparently represents the western extent of this species, which has a continuous distribution from Queensland down the eastern Australian coast. The specimens here at the apparent end of its range are smaller than have usually been recorded from other locations.

No constant difference has been detected between the South African *P. stolonifera* s. sp. *stolonifera* and the Australian *P. stolonifera* s. sp. *praeputialis* and most characters demonstrate a remarkable and overlapping range of variation in the two populations. The rounded fold of test enclosing the siphons, however, is never absent from Australian populations of this species, although it also has been reported from South Africa; occasionally projections of test surround the apertures of South African specimens but have never been observed in Australian forms. The different frequency with which these characters occur in each population suggest that subspecific rank is appropriate. This matter is discussed more fully by Kott (in press).

**Halocynthia hispida** (Herdman). Kott, 1968: 76 (synonymy); 1972a: 41; 1972b: 189.

*New Record:* upper Spencer Gulf (Stn G).

**Herdmania momus** (Savigny). Kott, 1972a: 41 (synonymy); 1972b: 189.

*New Record:* upper Spencer Gulf (Stn G); northern Great Australian Bight.

**Microcosmus planus** n. sp.

*Type Locality:* south of Goat I. (off Ceduna), 31 m deep, 17–25.xii.1967, Howlett. *Holotype:* NMV, 4284. *Paratypes:* SAM, E 1032; QM, G 7510.

FIG. 18

*Description:* The individuals are circular in outline and laterally flattened, with both apertures close together on the upper surface. The test is thin and completely encrusted with sand, so that the specimens resemble hardened discs of sand. The sand is maintained around the animal by hair-like extensions of the test, and posteriorly these are longer, so that a flattened sandy keel is developed which interrupts the circular outline of the body. It is apparent, therefore, that these laterally flattened individuals are embedded upright in the sand rather than lying on their side on the surface of the sea floor.

The apertures are sessile. Longitudinal muscles from both siphons radiate over the body, crossing one another in the middle of each side as is usual in this genus. There are also bands of circular muscles crossing the dorsal and ventral borders of the body. There is a conspicuous, elongate, dorsal ganglion between the two apertures. The branchial sac has 7 folds on each side of the body with six internal longitudinal vessels on each fold. Parastigmatic vessels are present. There are rectangular stigmata but no internal longitudinal vessels between the folds. The dorsal lamina is a wide, plain-edged, membrane. The gut forms the usual long, narrow, curved loop with liver lamellae in the pyloric region. The branchial tentacles are twice pinnate although the secondary branches are very short and rounded. The rectum extends anteriorly to the base of the atrial aperture, forming a deep curve with the gut loop. The anal aperture is bi-labiate. The gonads are present in the secondary gut loop and consist of a long ovarian tube often forming deep, close, curves. The ovarian tube has dense male follicles along its posterior border and on the lateral aspect of the ovarian tube against the body wall. As the curves of the ovarian tube develop, the male follicles appear to mingle with the ovary. Owing to the curving of the ovarian tube, it often appears to project back into lobes bordered by male follicles. The gonad on the right side of the body is in a corresponding position to that on the left.

**Remarks:** The species is unusual in the genus in that the gonads do not cross into the primary gut loop. In this respect only, it resembles *Microcosmus stolonifera*. The form of the gonads in the present specimens is, however, distinctive and the laterally flattened body is also diagnostic of the species.

**Microcosmus squamiger** (Michaelsen), Kott, 1972a: 43 (synonymy).

**New Records:** upper Spencer Gulf (Stn G); Outer Harbour (St Vincent Gulf).

**Remarks:** The present specimens have a thick test that is impregnated with sand, and in some cases numerous specimens form aggregates. The siphons are a rosy pinkish colour and there are the characteristic flattened scales lining the outer part of the siphons.

**Microcosmus nichollsi** Kott, 1972a: 42 (synonymy); 1972d: 245.

**New Records:** northern Great Australian Bight.

**Microcosmus stolonifera** Kott, 1972a: 43 (synonymy); 1972d: 245.

**New Records:** upper Spencer Gulf (Stn E1).

**Remarks:** The position of the left gonad in the secondary gut loop is characteristic of the species.

#### Family MOLGULIDAE

**Molgula mollis** (Herdman), Kott, 1952: 298; 1964: 144; 1972a: 45 (synonymy).

**Molgula sabulosa**, Kott, 1972d: 248.

**New Records:** upper Spencer Gulf (Stn B10); Investigator Strait (Stn Y1). For **Previous Records, Description**, see Kott 1972a (*Molgula sabulosa*).

**Remarks:** The specimens are small, more or less laterally flattened, spheres. The apertures are close together on the upper surface and a ridge of slightly thickened test extends between them. There are fine hairs on the lower part of the test which is completely encrusted with sand. The rim of the aperture is lobed but there are no hollow test expansions surrounding them as in *M. sabulosa* (see below). The apertures are directed away from one another. There are 7 branchial folds on each side of the body, with up to 9 internal longitudinal vessels on each distributed over both sides of each fold. There are no internal longitudinal vessels between the folds. The testis follicles form a complete circle at the end of the ovary, with a ligament extending through the centre of this

circle. On the lateral aspect of the ovary, it is apparent that the testis follicles embrace the end of the ovarian tube, but on the mesial aspect the U is completed to form a circle by the growth of the male follicles across the surface of the ovary. The male follicles are long and on their lateral aspect lie along the body wall directed from the periphery of the circle into the centre. On the mesial surface of the gonads, the testis follicles can be seen to be more or less fan-shaped and tightly packed with their outer border divided into separate lobes. The vas deferens extends from the centre of the circle of testis follicles and, viewed from the outside of the body, has two vasa efferentia connecting ducts from each individual testis follicle on each side. The vas deferens then extends mesially and along the surface of the ovarian tube and opens above the opening of the oviduct. The proximal part of the vas deferens is expanded into a seminal vesicle.

**Remarks:** The length of the oviduct and the absence of hollow test extensions around the apertures distinguish this species from the very similar *M. sabulosa* (see below) which has often been confused with it.

**Molgula sabulosa** (Quoy & Gaimard), 1834: 613. Michaelsen & Hartmeyer, 1928: 449 (synonymy). Kott, 1952: 298 (part); 1972b: 190. Millar, 1966: 374.

**Remarks:** There are no new records for this species; however, a small specimen from Elliston has made it possible to compare the species characteristics with those of *M. mollis* with which it has been confused. It is clear that the differences in the two species are not associated with maturity. *M. sabulosa* is spherical with a sandy test that is hard and brittle, while *M. mollis*, although encrusted with test, has fine hairs to which the sand adheres, the test itself is more flaccid, and the preserved specimens are laterally flattened. The branchial aperture is always protected by 6 pointed lobes from the surrounding test a little distance from the opening while the rim of the aperture itself is produced into 6 smaller pointed lobes, that are covered in the closed position by the rim of the larger lobes. The atrial aperture is protected by two flattened, wide tongues and their border is separated into three rounded lobes that arise from the test at the dorsal and ventral sides of the opening. The rim of the aperture itself is produced into 4 small,



pointed, sandy lobes and these are covered by the larger lips in the closed position. All these extensions from the test around the apertures are hollow and have prolongations of the body wall extending into them. They are characteristic of the species and are never present in *M. mollis*. The gonad in the present species, while superficially resembling that of *M. mollis*, has a very short vas deferens that opens at the proximal end of the ovary on its mesial surface.

### Biogeography

The 22 species recorded from the northern part of the Great Australian Bight (including Ceduna), as far as 32°24'S, 133°30'E, can be divided into the following groups:

1. *Possibly endemic to the Great Australian Bight.*

*Patridium pulvinatum* n. sp.; *Aplidium digitatum* n. sp.; *Aplidium foliorum* n. sp.; *Leptoclinides volvus* n. sp.; *Paraborryllus nemorus* n. sp.; *Pyura tendata* Kott; *Microcosmus planus* n. sp.

2. *Southern temperate* (recorded also from South Africa).

*Aplidium flavolineatum* (Sluiter); *Aplidium colelloides* (Herdman).

3. *Circum-australian.*

*Polychor giganteum* (Herdman); *Leptoclinides reticulatus* (Sluiter); *Leptoclinides rufus* (Sluiter); *Polysyncrator aspiculatum* Tokioka; *Didemnum candidum* Savigny; *Didemnum moseleyi* (Herdman); *Amphicarpa diptycha* (Hartmeyer); *Polycarpa pedunculata* (Heller); *Cnemidocarpa etheridgei* (Herdman) (absent only from tropical Australia); *Herdmania momus* (Savigny).

4. *Southern and eastern Australian species.*

*Ascidia aelara* Kott; *Styela pedata* (Herdman); *Pyura pachydermatina* (Herdman) *gibbosa* (Heller); *Pyura spinifera* (Quoy & Gaimard); *Microcosmus nichollsi* Kott (absent only from tropical Australia).

The apparently endemic species comprise a considerable component (31%) of the fauna in the northern part of the Great Australian Bight. The circum-Australian forms comprise almost 50% of the species, while species with a range to Port Jackson (*Pyura p. gibbosa*, *P. spinifera*) or Moreton Bay (*Ascidia aelara*, *Styela pedata*, *Microcosmus nichollsi*) also occur. The three latter records extend the known range to the west, although the first two species are already known to occur in southwestern Australia. The data that are

recorded here do not therefore disagree with previous information (Kott 1972b) that supports the existence of a marine faunal Province extending from Cockburn Sound (or further to the north) on the western Australian coast to the vicinity of the eastern coast of South Australia.

There is no evidence that would suggest that the sample that is available is not typical of the fauna of the Great Australian Bight. This fauna, however, does not, on the basis of available data, appear to be typical of the Flindersian marine faunal Province. Apart from the large endemic component, the species occurring there have a wide distribution around the Australian coast, especially along the eastern seaboard. The species that terminate their range at the eastern end of the Flindersian Province have not been taken in these collections from the northern part of the Great Australian Bight (Kott 1972b), although they have been recorded at more easterly locations off South Australia.

Other species in this collection taken from other locations off the South Australian coast may be grouped according to the South Australian limits of their range in the following way:

1. *Species that do not extend eastwards into the Maugean marine Province.*

*Podoclavella cylindrica* (Quoy & Gaimard); *Pyenoclavella diminuta* (Kott); *Alapozoa marshii* Brewin; *Diplosoma translucidum* Hartmeyer; *Polyclinum neptunium* (Hartmeyer); *Stolonica carnosus* Millar; *Molgula sabulosa* Kott.

2. *Species that do not extend westwards into the Flindersian marine Province.*

*Distaplia australiensis* Brewin; *Eubherdmania australis* Kott; *Aplidium coniferum* Kott; *Aplidium amorphatum* Kott; *Ascidia thompsoni* Kott; *Polyandrocarpa lapidosa* (Herdman); *Pyura irregularis* (Herdman); *Polycarpa tinctor* (Quoy & Gaimard); *Polycarpa papillata* (Sluiter).

3. *Species for which the Flindersian/Maugean boundary does not comprise a barrier.*

*Sycosia cerebriiformis* (Quoy & Gaimard); *Sycosia pedunculata* (Quoy & Gaimard); *Ritterella herdmania* Kott; *Trididemnum savignii* (Herdman); *Trididemnum cerebriiforme* (Hartmeyer); *Symplegma viride* Herdman; *Pyura australis* (Quoy & Gaimard); *Microcosmus stolonifera* Kott.

4. *Gulf fauna.*

*Pyura scoresbiensis* Kott.

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## Appendix—Station List

- NORTHERN GREAT AUSTRALIAN BIGHT (32°24'S, 133°30'E), May 1973, Experimental Prawn Trawl, Explorer (Coll. P. Symond).
- 42 m: *Polycitor giganteum*  
*Patridium pulvinatum* n. gen. n. sp.  
*Aplidium coeloides*  
*Aplidium foliorum* n. sp.  
*Leptoclinides volvus* n. sp.  
*Herdmania momus*
- 49 m: *Aplidium coeloides*  
*Aplidium flavolineatum*  
*Aplidium digitatum* n. sp.  
*Leptoclinides reticulatus*  
*Polysyncrator aspiculatum*  
*Didemnum candidum*  
*Didemnum moseleyi*  
*Amphicarpa diptycha*  
*Polycarpa pedunculata*  
*Styela pedata*  
*Cnemidocarpa etheridgii*  
*Pyura pachydermatina gibbosa*  
*Pyura spinifera*  
*Herdmania momus*  
*Microcosmus nichollsi*
- GOAT ISLAND, off Ceduna, Great Australian Bight (Coll. P. Howlett).
- 32 m: *Ascidia aclara*  
*Pyura tendata*  
*Microcosmus planus* n. sp.
- ELLISTON BAY, Feb. 1971 (Coll. S. A. Shepherd).
- Outside bar:  
*Euherdmania australis*  
*Ritterella herdmania*  
*Aplidium amorphatum*  
*Leptoclinides rufus*  
*Oculinaria australis*
- Reef: *Symplegma viride*  
*Aplidium coniferum*
- Vertical faces (25 m): *Pyura pachydermatina*  
*Molgula sabulosa*
- WEST ISLAND: Amphitheatre Rock
- 7 m deep, 13.vii.1972:  
*Polycitor giganteum*
- 17 m deep, 12.vii.1972:  
*Sycosoa cerebriiformis*
- CAPE JAFFA: Margaret Brock Reef (3-4 m deep and in caves), 28.xi.1972.  
*Pseudodistoma cereum*
- INVESTIGATOR STRAIT, January, 1971 (Coll. J. E. Watson).
- Station XI (depth 19 m):  
*Aplidium pronum* n. sp.  
*Diplosoma translucidum*  
*Pyura australis*
- Station X3:  
*Pyura australis*
- Station X7:  
*Herdmania momus*
- Stations X8, X9, X10:  
*Pyura scoresbiensis*
- Station Y1:  
*?Polyclinum neptunium*  
*Stolonica carnosa*  
*Polyandrocampa lapidosa*  
*Molgula mollis*
- Station Y5:  
*Atapozoa marshi*  
*Euherdmania australis*  
*?Polysyncrator aspiculatum*  
*Pyura australis*
- Station Z6:  
*Atapozoa marshi*
- UPPER SPENCER GULF, September, 1973. Transects and stations of S. A. Shepherd, Department of Fisheries, S. Aust.
- Transects A-D:  
*Polycarpa pedunculata* (arenaceous and naked specimens, sometimes growing side by side, attached to the same shell or stone, stalked or sessile).
- Station A1 on Pinna, depth 0-1 m:  
*Pyura irregularis*  
*Pyura vittata*
- Station A5, depth 17 m:  
*Ascidia thompsoni*  
*Polycarpa pedunculata*
- Station A7, depth 10 m:  
*Polycarpa pedunculata* (2 spec.)
- Station B4, depth 17 m:  
*Sycosoa pedunculata*
- Station B7, depth 5 m:  
*Polycarpa pedunculata* (some naked, black; a few leathery)  
*Polycarpa papillata* (single specimen)  
*Pyura irregularis* (one small aggregate)

- Station B10, depth 10 m, channel:  
*Polycarpa tinctor*  
*Molgula mollis*
- Station C4, depth 12 m:  
*Polycarpa pedunculata* (naked and arena-  
 ceous)
- Station D3, depth 18 m:  
*Ascidia thompsoni*
- Station D5, depth 15 m:  
*Distaplia australiensis*
- Station D9, depth 10 m:  
*Pyura scoresbiensis*
- Station E1, depth 7 m:  
*Polycarpa pedunculata*  
*Microcosmus nicholli*  
*Microcosmus stolonifera*
- Station E3, depth 9 m:  
*Ascidia thompsoni*
- Station E4, depth 5 m:  
*Pyura irregularis*
- Station F1, depth 19 m:  
*Polycarpa pedunculata* (small stalked,  
 arenaceous)
- Station F3, depth 19 m:  
*Pyura scoresbiensis* (without stalk)
- Station F4, depth 16 m:  
*Ascidia thompsoni* (with barnacles)
- Station G, depth 9 m:  
*Ascidia thompsoni*
- Parabotryllus nemorus* n. gen., n. sp.  
*Polycarpa pedunculata*  
*Pyura scoresbiensis*  
*Halocynthia hispidula*  
*Microcosmus squamiger*  
*Herdmania momus*
- Reef, 4 km NNW Douglas Bank:  
*Podoclavella cylindrica*  
*Pyura australis*
- SPENCER GULF.
- Tipara Reef, depth 11 m, 24.ix.1971:  
*Pycnoclavella diminuta*  
*Pyura irregularis*
- Under stones:  
*Herdmania momus*
- Depth 5 m, 2.v.1972:  
*Podoclavella cylindrica*
- ST VINCENT GULF.
- Port River (near Electricity Trust), depth 3 m,  
 muddy bottom, 9.vi.1972:  
*Styela plicata*
- Outer Harbour:  
*Pyura stolonifera*  
*Microcosmus squamiger*
- Sellick Beach (S of Adelaide), Feb. 1972 (Cell.  
 R. Hammond):  
*Trididemnum savignii*  
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